Ref.T4/4.03

INTERIM GUIDELINES ON THE TEST PROCEDURE FOR DEMONSTRATING THE EQUIVALENCE OF COMPOSITE MATERIALS TO STEEL UNDER THE PROVISIONS OF THE 1974 SOLAS CONVENTION

1 The Maritime Safety Committee, at its sixty-sixth session (28 May to 6 June 1996), noting the necessity of establishing an international test procedure for composite material to be used as an equivalent material to steel under the provisions of SOLAS chapter II-2, approved Interim Guidelines on the test procedures for demonstrating the equivalence of composite materials to steel, as set out in the annex.

2 The Interim Guidelines are intended to provide a test procedure to demonstrate the ability of composite materials which are used as load-bearing "A" or "B" class divisions to withstand the applied loads during and at the end of fire, when applying the standard fire test procedure to "A", "B" and "F" class divisions, adopted by the Organization by resolution A.754(18) and additional tests on small specimens to determine the high temperature strength properties of the material.

3 Member Governments are invited to:

.1 use the Interim Guidelines when demonstrating the equivalence of composite materials to steel under the provisions of SOLAS regulation II-2/3.7; and

.2 encourage research and studies on composite materials and provide the Organization with the results of any relevant studies as well as information on the experience gained from the use of these Interim Guidelines.

4 The Committee agreed that, in view of the interim nature of the guidelines, they should be reviewed, as necessary, after sufficient information is obtained as requested in paragraph 3.2 above.

ANNEX

INTERIM GUIDELINES ON THE TEST PROCEDURE FOR DEMONSTRATING THE EQUIVALENCE OF COMPOSITE MATERIALS TO STEEL UNDER THE PROVISIONS OF THE 1974 SOLAS CONVENTION

General

1 For the purpose of applying composite materials for load-bearing "A" class of "B" class divisions of superstructures, structural bulkheads except for those in contact with liquids, decks and deckhouses of ships, as equivalent to steel, it should be demonstrated that they are able to withstand the applied loads during and at the end of fire, by means of the following test procedure.

2 The composite materials should meet criteria of non-combustibility, passage of smoke/flame and toxicity as determined by relevant test procedures developed by the Organization[1]

Definitions

3 The following definitions apply for the purpose of these guidelines:

.1 **Composite material** means a material with an organic or inorganic matrix (e.g. polyester, melamine formaldehyde, phenolic resins or ceramic), reinforced by fibres (e.g. glass, carbon, ceramic fibres) with suitable orientation.

.2 **Composite strength** means the tension, compression, bending, shear and torsion ultimate strength at each temperature multiplied by a safety factor assigned to the satisfaction of the Administration (e.g. 0.8) (see figure 1).

.3 **Core region** means the inner part or the outer part not exposed to fire of the load-bearing division, capable of a minimum residual strength and stiffness to withstand the applied loads during and at the end of fire.

.4 **Insulation** means the outer part of the load-bearing division with suitable thickness to ensure thermal protection of the core region (i.e. the structural strength of the insulating material, if any, should be fully disregarded).

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[1]Refer to:

.1 Improved recommendation on test method for qualifying marine construction materials as non-combustible (resolution A.472(XII)).

.2 Recommendation on fire test procedures for "A", "B" and "F" class divisions (resolution A.754(18)).

.3 Interim standards for measuring smoke and toxic product of combustion (resolution MSC.41(64)).

.5 **Load-bearing division** means a panel made of composite material(s) (e.g. layers of laminates, adhesives bonds and a core region of composite or other materials) which is able to withstand the applied functional, environmental and local loads.

.6 **Transition temperature** means the temperature corresponding to an abrupt loss of stiffness of the material (see figure 2, when applicable).

Determination of structural properties

3 Tests should be performed on small specimens of suitable shape, including all the elements of the core region. Such specimens should be tested in a uniform temperature furnace and the temperature of the core region should be determined, to define the behavioural relationship between the applied loads and temperature.

4 The tension, compression, bending, shear and torsion loads appropriate for the material's application on board, should be scaled and applied in specimens with a different orientation to take account of the anysotropic behaviour of the composite material.

5 Tests should be performed at a temperature of the furnace increasing from the ambient temperature to the temperature foreseen for the core region at the end of the standard fire test on the prototype of the division of composite material.

6 The composite strength should be scaled from the dimensions of the small specimens to the actual dimensions of the composite material used on board.

Selection of the critical temperature

7 The critical temperature is the temperature of the composite strength corresponding to the most critical applied load relative to the application on board. When the application involves a combination of load (e.g. compression and bending), the most critical load should be defined for the most unfavourable load combination.

8 The critical temperature should not exceed the transition temperature, when applicable, to ensure that deformation is adequate for the intended application.

Performance of standard fire tests

9 Standard fire tests should be performed on larger scale specimens, in accordance with the provisions of SOLAS regulation II-2/3.2 and the Recommendation on Fire Test Procedure for "A", "B" and "F" Class Divisions, adopted by the Organization by resolution A.754(18).

10 In addition to SOLAS regulations II-2/3.3 and II-2/3.4, the temperature in any point of the most exposed side of the core region of load-bearing divisions should be lower than the critical temperature. Special considerations should be given to the measured temperatures, thermal distortions and transmission of loads of joints.

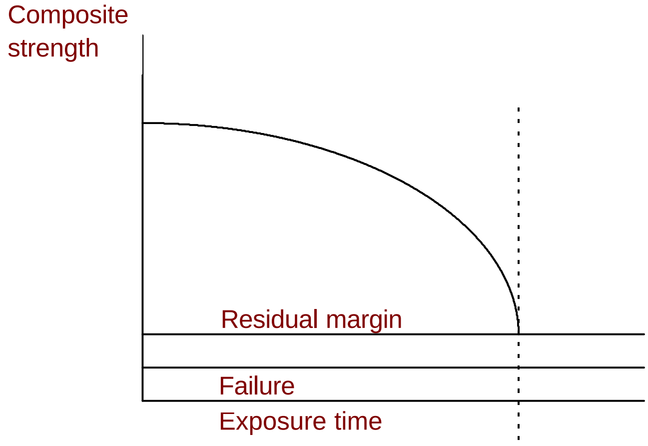

Figure 1 - Example of structural stiffness reduction

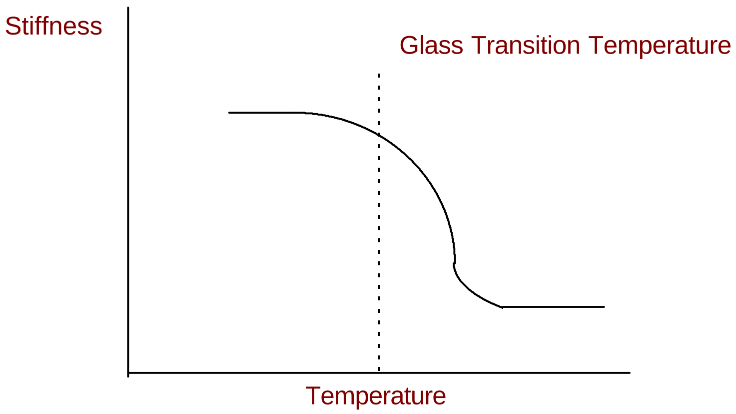

Figure 2 - Typical stiffness-temperature relation

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